

MONITORING LACEWINGS (INSECTA: NEUROPTERA) IN SOUTHERN AFRICA

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A concerted research programme is being undertaken on southern African Neuroptera. This has been formally structured into five operational components or focal areas: a biodiversity audit, systematic revisions, study of larval biology and ecological requirements, distribution patterns and predictive modelling, and conservation status and protective measures. The programme is being undertaken in collaboration with local and international researchers, while amateur entomologists also make significant contributions.

Key words: Southern Africa, Neuroptera, ecology, biogeography, predictive modelling, conservation

INTRODUCTION

Southern Africa has an especially rich and varied fauna of lacewings (Insecta: Neuroptera), including 12 of the 17 recognised families. Approximately 500 species are estimated to occur in the region south of the Cunene and Zambezi rivers. About half of these are endemic to the sub-region, but they are vulnerable to habitat fragmentation and pesticide contamination. Neuroptera are consequently excellent indicators of environmental and habitat transformation, and also include key species for signifying areas and faunas that require priority protection. They are ideal subjects for scientific research owing to their diverse and cryptic lifestyles, and because of the restricted distributions and phenology of endemic species. Adults of several families pollinate indigenous flora, with Nemopteridae being particularly significant in this regard. All larvae are specialised predators with unique, highly evolved mouthparts that clearly delimit Neuroptera as a monophyletic group. Because of their predatory habits, lacewing larvae impact upon populations of other insects and small Arthropoda, and are sought after as biological control agents.

A research programme to document and monitor the rich but vulnerable fauna of southern Africa is in progress, and involves both local and international collaborators. The stimulus for this concerted research effort was provided by the classic studies of BØ TJEDER (1957, 1959, 1960, 1966, 1967), who laid the founda-

tions to neuropterology in southern Africa and, in the process, posed many challenging questions to his successors.

The programme has five main objectives (Fig. 1): (1) a biodiversity audit, (2) systematic revisions, (3) elucidation of larval biology and ecological requirements, (4) distribution patterns and predictive modelling, (5) conservation status and protective measures. These areas have been identified to focus research on southern African lacewings into a formal structure with clearly defined goals.

THE BIODIVERSITY AUDIT

This aspect is fundamental to the other focus areas, its main objective being to determine which taxa occur in southern Africa. It involves ongoing collecting in all areas of the sub-region, as well as recording historical data from specimens in collections, locally and abroad.

Adult Neuroptera are collected by means of non-destructive light-traps (OBERPRIELER 1984) and by beating and sweeping vegetation. All material is pinned, and collection data are entered into the “*Palpares* Relational Database” that was designed for this purpose (MANSELL & KENYON 2002). Specimens are housed in the South African National Collection of Insects (SANC) and in other public and private collections. There are currently 31 000 specimens of Neuroptera in SANC, accommodated in 12 cabinets comprising 480 drawers.

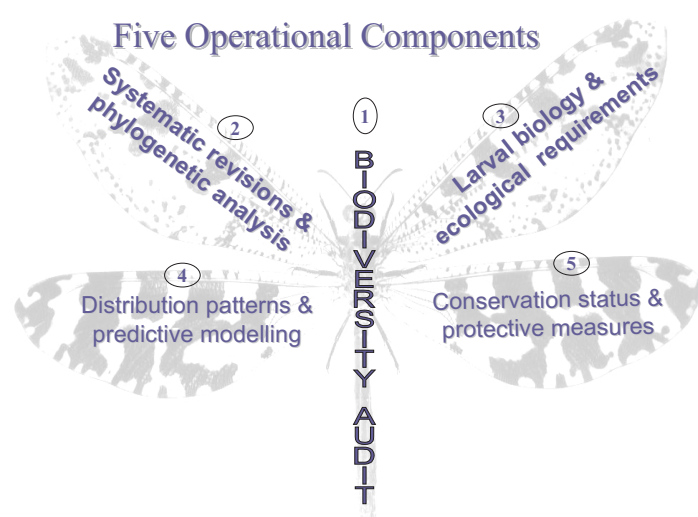


Fig. 1. Diagram of the main focus areas of the Southern African Lacewing Monitoring Programme

Many persons, whose names are recorded in the database, have collected and donated specimens to the programme. This is an important source of data, and several have made significant contributions to our knowledge of southern African Neuroptera. Field work by SANC personnel has yielded many specimens, while recent collaborative expeditions with overseas and local colleagues have considerably enhanced collection holdings of Neuroptera. These collaborators include, H. ASPÖCK, U. ASPÖCK, H. HÖLZEL (Austria), P. OHM (Germany), R. B. MILLER, L. A. STANGE, J. D. OSWALD (U.S.A.), and L. R. MINTER. M. D. PICKER and C. H. SCHOLTZ (South Africa). The 1988 excursions that followed the Third International Symposium on Neuropterology also yielded a significant list of southern African Neuroptera (MANSELL & ASPÖCK 1990).

SYSTEMATIC REVISIONS

The main focal area that emanates from the Biodiversity audit is the documentation of southern African Neuroptera. The early literature on Coniopterygidae, Sisyridae, Osmylidae, Berothidae, Psychopsidae, Chrysopidae, Hemerobiidae and Nemopteridae was reviewed by TJEDER (1957, 1959, 1960, 1966, 1967), while MANSELL (1985) discussed historical literature pertaining to Myrmeleontidae from the sub-region. SMITHERS (1957, 1961) published two papers on local Sisyridae. TJEDER (1968, 1987, 1989, 1992) and TJEDER & HANSSON (1992) subsequently presented additional information on Ascalaphidae, Rhachiberothidae and Coniopterygidae.

Recent studies by ASPÖCK and ASPÖCK (1983, 1988*a,b*, 1990, 1996, 1997) (Berothidae, Rhachiberothidae), ASPÖCK and MANSELL (1994) (Rhachiberothidae), ASPÖCK and NEMESCHKAL (1998), HÖLZEL (1987, 1989, 1990*a,b*, 1991, 1992, 1993), HÖLZEL and OHM (2002) and HÖLZEL *et al.* (1997) (Chrysopidae), MANSELL (1976, 1977, 1980, 1981*a,b*, 1985, 1987, 1988, 1990, 1992, 1996) (Nemopteridae, Myrmeleontidae), MANSELL and ASPÖCK (1990) and MANSELL (2000) (species lists), MEINANDER (1972, 1975, 1983, 1998) and MONSERRAT (1998) (Coniopterygidae), MINTER (1986) (Dilaridae), OSWALD (1993, 1994) (Psychopsidae) and PICKER (1984, 1987) (Nemopteridae) have contributed significantly to documenting the taxonomy and distribution of southern African lacewings.

Studies on Chrysopidae, Hemerobiidae, Coniopterygidae, Berothidae, Rhachiberothidae, Myrmeleontidae, Ascalaphidae and Nemopteridae are ongoing, and have been elaborated by ASPÖCK (2002). A catalogue of South African Neuroptera is available on a web site (<http://www.ru.ac.za/zoology/martin/insects.html>), and this is to be expanded to include all sub-Saharan taxa.

LARVAL BIOLOGY AND ECOLOGY

The immature stages of southern African Neuroptera are poorly known. Only a few publications have included information on larval morphology and biology, and only the Crocinae (Nemopteridae) have been comprehensively studied (MANSELL 1976, 1977, 1980, 1981*a,b*, CROSS & MANSELL 1978). One paper (MANSELL 1973) described a larva of Nemopterinae (Nemopteridae), while three include information on Myrmeleontidae (MANSELL 1987, 1988, 1999). HENRY (1979) provided a detailed description of an unidentified larva of Ascalaphidae from Kwa-Zulu/Natal, and Chrysopidae have been detailed in two papers (BARNES 1975, HÖLZEL *et al.* 1997). A description of the morphology and biology of an unidentified mantispid (Mantispidae) was provided by BISSETT and MORAN (1967), while MINTER (1990) presented details of the early stages of a species each of Berothidae, Rhachiberothidae and Mantispidae. The larvae of southern African Coniopterygidae, Sisyridae, Osmylidae, Hemerobiidae, and Psychopsidae have not yet been described, while very few larvae of the families Chrysopidae, Berothidae, Rhachiberothidae, Mantispidae, Nemopteridae and Ascalaphidae have been found. Extensive studies are being carried out on larvae of Myrmeleontidae by the author, and approximately 40 species have been discovered and reared.

The larval stage of Neuroptera is of the longest duration in the life cycle, it is the main feeding stage and requirements are entirely different from those of the adult. A separate suite of parameters impact upon the evolution of larvae, and on the survival and distribution of species. It is consequently essential to investigate the larvae and their environmental requirements when considering the status and conservation of species.

Larvae of lacewings are also frequently applied in biological control programmes (STELZL & DEVETAK 1999) and southern African species have considerable potential in this regard, especially the Chrysopidae and Coniopterygidae, and Myrmeleontidae for the control of ants in orchards.

Research on larvae is clearly a focal area that holds exciting potential for investigation and application, and is regarded as a high priority.

DISTRIBUTION PATTERNS AND PREDICTIVE MODELLING

The geo-referenced locality data that are recorded in the database during the biodiversity audit are used to compile distribution patterns for species. This forms the basis of several applications that are fundamental to biodiversity studies and conservation strategies. This aspect of the lacewing Monitoring Programme is car-

ried out in collaboration with the Conservation Planning Unit of the Department of Zoology and Entomology at the University of Pretoria. It is also a component of the SA ISIS2000 programme that is funded by the National Department of Arts, Culture, Science and Technology, through the Conservation Unit, headed by A. S. VAN JAARSVELD.

The lacewing data are implemented in Geographical Information Systems (GIS) modelling procedures that are applied to address several issues. These include predictive modelling for climate change scenarios (ERASMUS *et al.* 2000), identification of areas of species richness, endemism and in reserve selection based on objective parameters (FREITAG & MANSELL 1997). This is of fundamental value to long-term ecological and conservation planning, and in sustainable development, and is of particular relevance to land-use planners and in environmental impact assessments. These products again emphasise the value of long-term taxonomic research and collaboration on southern African lacewings.

CONSERVATION STATUS AND PROTECTIVE MEASURES

The ultimate goal of accumulating specimens, associated data and the integration and analysis of the information, is to monitor the status of lacewings to ensure the conservation and survival of this rich and unique southern African heritage. The information obtained is used to model current protective measures, such as species that are protected within reserves (FREITAG & MANSELL 1997), and to identify areas that harbour vulnerable species, especially endemics, or areas that are particularly rich and in need of protection.

Many southern African species are rare, critically endangered or possibly extinct, but their status must be established and protective measures implemented should populations be discovered. Critically endangered species include: *Pamexis bifasciatus* (OLIVIER), *P. contamminatus* (HAGEN), *Exaetoleon obtabilis* (PÉRINGUEY) (Myrmeleontidae), *Sicyoptera dilatata* (KLUG), *S. cuspidata* TJEDER, *Halterina pulchella* (PÉRINGUEY) and *H. purcelli* (PÉRINGUEY) (Nemopteridae). All of these species are in the southwestern regions of the Western Cape Province, where habitat destruction is extensive. Single populations of *P. contamminatus*, *S. dilatata* and *S. cuspidata* have recently been discovered by R. D. STEPHEN, J. B. BALL and M. W. MANSELL, and the status of these will be monitored by revisiting the sites and informing land owners of their vulnerable presence.

CONCLUSIONS

Information emanating from this programme will contribute to knowledge of the biodiversity and ultimate conservation of the rich, but vulnerable fauna of Neuroptera of southern Africa. It is also intended to produce marketable products in the form of comprehensive data-sets and tools (databases and GIS models) that can be applied in further research, objective decision making and land-use planning. These demand-driven applications emphasise the relevance of biological collections and taxonomic research, and ensure the viability of such endeavours. It also highlights the value of collaborative and co-ordinated research, where limited resources and effort are focussed towards specific goals.

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